Reflight of the Stratospheric TeraHertz Observatory: STO-2 JHU/APL Co-I

Completed Technology Project (2014 - 2016)

Project Introduction

This is a collaboration Co-I Institution proposal for the proposal 'Reflight of the Stratospheric TeraHertz Observatory: STO-2' whose lead proposal is submitted by the University of Arizona with Christopher Walker as PI. STO-2 will address a key problem in modern astrophysics, understanding the Life Cycle of the Interstellar Medium (ISM). STO-2 will survey approximately Â? of the Southern Galactic plane in the dominant interstellar cooling line [CII] (158 Âµm) and the important star formation tracer [NII] (205 Âµm). With ~1 arcminute angular resolution, STO-2 will spatially resolve atomic, ionic and molecular clouds out to 10 kpc. Taking advantage of its enhanced, extended lifetime cryogenic receivers, the STO-2 survey will be conducted at unparalleled sensitivity levels. STO-2 will uniquely probe the pivotal formative and disruptive stages in the life cycle of interstellar clouds and the relationship between global star formation rates and the properties of the ISM. Combined with previous HI and CO surveys, STO-2 will create 3-dimensional maps of the structure, dynamics, turbulence, energy balance, and pressure of the Milky Way's ISM, as well as the star formation rate. Once we gain an understanding of the relationship between ISM properties and star formation in the Milky Way, we can better interpret observations of nearby galaxies and the distant universe. The mission goals for these surveys are to: • Determine the life cycle of Galactic interstellar gas. • Study the creation and disruption of star-forming clouds in the Galaxy. • Determine the parameters that affect the star formation rate in the galaxy. • Provide templates for star formation and stellar/interstellar feedback in other galaxies. STO-2 will re-use the 80cm telescope, gondola, and subsystems from STO-1. For the STO-2 flight, STO-1's high spectral resolution (<1 km/s) heterodyne receiver system will be upgraded for extended cryogenic lifetime, enhanced sensitivity, and greater reliability. The flight receiver has eight, cryogenic HEB mixers; four optimized for the [CII] line and four for the [NII] line. STO-2 will also fly an uncooled, Schottky receiver to observe the 609 Âµm [CI] line at 3 arcminute resolution. The instrument spectrometer has sufficient bandwidth to detect all clouds participating in Galactic rotation in each of its 9 pixels. STO is capable of detecting every giant molecular cloud, every HII region of significance, and every diffuse HI cloud with (AV â‰¥ 0.4) within its survey region. The STO-1 launch was on 15 January 2012. Before achieving float altitude a frozen absolute pressure regulator vented approximately half of the liquid helium supply to the atmosphere. This event reduced the cryogenic (THz) portion of the mission to ~5 days. The efficacy of the observations conducted during this period was hindered by several technical issues experienced early in the flight. The causes of these issues were identified and corrected in flight. STO then transitioned into its `Warm Mission' science program and continued observations using an uncooled 492 GHz [CI] receiver until the end of its flight on 29 January 2012. Here we propose to re-fly STO with an upgraded, more robust cryogenic/receiver system that will allow THz observations to continue until stratospheric conditions or recovery constraints require terminating the mission (up to ~60 days). STO-2 will benefit tremendously from the heritage

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Organizational Responsibility

Responsible Mission Directorate:

Science Mission Directorate (SMD)

Responsible Program:

Astrophysics Research and Analysis

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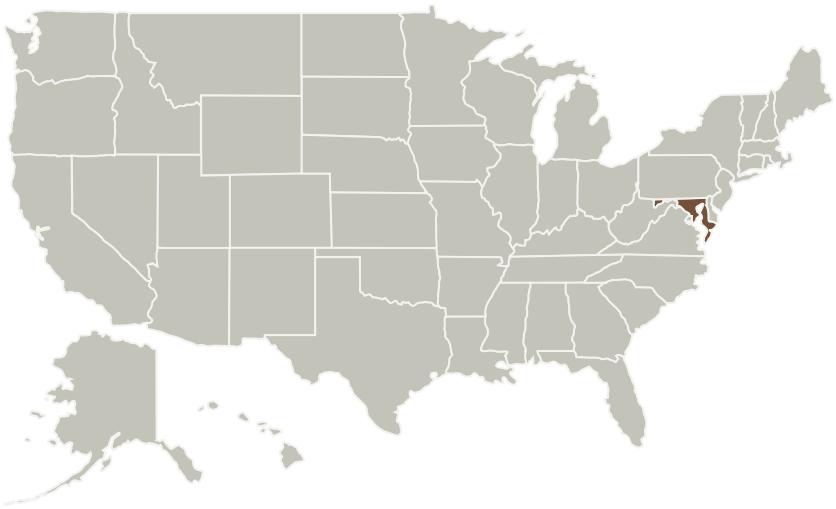
and experience gained during the STO-1 campaign.

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Johns Hopkins University Applied Physics Laboratory(JHU/APL)	Supporting Organization	R&D Center	Laurel, Maryland

Primary U.S. Work Locations
Maryland

Project Management

Program Director:

Michael A Garcia

Program Manager:

Dominic J Benford

Principal Investigator:

Pietro N Bernasconi

Co-Investigators:

Harry Eaton
Matthew W Noble

Technology Areas

Primary:

- TX08 Sensors and Instruments
  - TX08.1 Remote Sensing Instruments/Sensors
    - TX08.1.4 Microwave, Millimeter-, and Submillimeter-Waves

Target Destination

Outside the Solar System